

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-350200

(43)Date of publication of application : 21.12.1999

(51)Int.Cl. C25F 7/00
C23F 1/08

(21)Application number : 10-160446

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(22)Date of filing : 09.06.1998

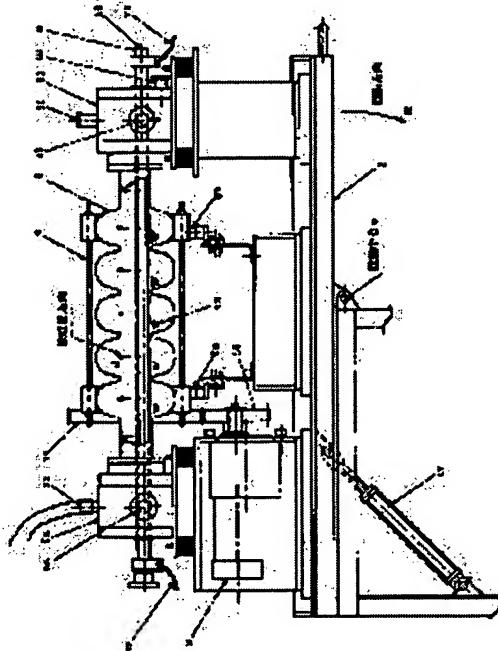
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(54) METHOD FOR POLISHING INSIDE SURFACE OF METALLIC HOLLOW BODY AND POLISHING APPARATUS THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for polishing the inside surface of a metallic hollow body which is capable of preventing the unevenness of polishing, the leakage of a polishing liquid and safely and cost effectively carrying out work and a novel polishing apparatus usable for the same.

SOLUTION: While the metallic hollow body 1 is kept rotated in the state of horizontally holding the body in a longitudinal direction, approximately the lower half body of its inside is immersed into the polishing liquid 13 and only the inside surface is polished. A liquid feed pipe 6 has a plurality of discharge holes at every suitable interval along its longitudinal direction and the respective discharge holes discharge the polishing liquid 13 perpendicularly upward. While the metallic hollow body 1 is rotated after the end of the polishing, the metallic hollow body is erected to the state that the longitudinal direction is perpendicular. The polishing liquid 13 is then withdrawn. The washing work and the insertion and removal work of the liquid feed pipe 6 are carried out in the state that the longitudinal direction of the metallic hollow body is perpendicular. Members 5a, 5b which enable liquid



feeding and discharging and air sucking and discharging while maintaining the rotation by sealing both end apertures of the hollow body 1 are composed only of the org. material having chemical resistance.

LEGAL STATUS

[Date of request for examination] 09.06.1998

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 2947270

[Date of registration] 02.07.1999

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] in the inside of the metal hollow object used in the field of a vacuum equipment, this invention is performed smooth and in order to defecate -- it is related with chemical, the electrolytic-machining approach, and its equipment. Especially the hollow object that ground safely the metal hollow object made from niobium, copper, stainless steel, and aluminum about the approach of grinding only an inside alternatively and graduating it, and its equipment, in more detail can be used as an inside, a beam pipe, etc. of the acceleration cavity used for an elementary-particle accelerator etc.

[0002]

[Description of the Prior Art] As the polish approach of the hollow object made from niobium used as a conventional, for example, superconduction, acceleration cavity, two kinds, the approach ("chemical polishing" is called henceforth) of grinding chemically and the approach ("electrolytic polishing" is called henceforth) of grinding electrochemically, are known. As chemical polishing, using the mixed liquor of fluoric acid, a sulfuric acid, and the acid that consists of water, and niobium material being immersed into it, and grinding the whole surface flat and smooth chemically is known as indicated by the Provisional-Publication-No. No. 114669 [57 to] official report, for example. Moreover, it is also common knowledge to use the mixed liquor which consists of fluoric acid, a phosphoric acid, and a nitric acid as polish liquid used for the **-purpose. Anyway, since these approaches are immersed in polish liquid in the whole hollow object, although the activity itself is simple, it will be ground to the external surface of a hollow object unnecessary originally, and there is a problem of unnecessary contamination of liquid or aging, and there is a problem of producing a remarkable difference in the amount of polishes according to the immersion direction of a polish object. There are many difficulties - the gas which the polish liquid by the occurring gas stirs this, and the operation is involving, and occurs adheres to the internal surface depending on the configuration of a hollow object, and spoils a polish appearance.

[0003] And intermittence electrolytic polishing which repeats repeatedly rotating it after carrying out partial immersion of the lower half of a hollow object into the polish liquid which consists of fluoric acid, a sulfuric acid, and water where both-ends opening of a niobium hollow object is leveled, carrying out short-time energization to the Japanese Patent Publication No. No. 12116 [55 to] official report, carrying out partial electrolytic polishing by the idle state to it and stopping energization subsequently in it, and carrying out dissolution removal of the oxide film again at it, and performs it is indicated. In addition to generating of the polish level difference nonuniformity by the unnecessary dissolution loss and short-time halt polish of a hollow object configuration material, having un-arranged [which it is called unnecessary contamination / exhausting / of polish liquid itself], since this approach originally also ground to coincidence the external surface of the hollow object which does not need polish. In addition, vaporization nature called fluoric acid serves as a high activity handling what generates harmful high gas, and febrile high drugs called a sulfuric acid of danger extremely.

[0004] In this semantics, JP,61-23799,A It is what tends to be rotated continuously and is going to carry

out continuation electrolysis of the polish liquid in the state of through and partial immersion only inside the hollow object made from niobium, using the polish liquid which consists of the same fluoric acid, a sulfuric acid, and water. It is the high polish approach of the safety which does not cause the dissolution of niobium material vainly while compaction of polish time amount can be measured, therefore exhausting [polish liquid / unnecessary / exhausting / contamination or] do not have, and is the electrolytic-polishing approach remarkably improved compared with the approach of the Japanese Patent Publication No. No. 12116 [55 to] official report. However, when this approach is actually enforced and is seen, a problem is in the discharge direction of polish liquid. Produce polish appearance nonuniformity inside the hollow object made from niobium, or There was a problem that the seal device for rotating that it is difficult to carry out without contacting electrode mounting/unmounting to the interior of a hollow object on a stand and a hollow object, and dipping will be imperfect, and leakage and O ring for dynamic usage of polish liquid will carry out way consumption immediately.

[0005]

[Problem(s) to be Solved by the Invention] In the polish to which this invention is performed for the purpose of removal of a damaged layer, defecation, and smoothing in the internal surface of a metal hollow object It is, and it carries out, dissolution removal of the material is carried out electrochemically, there is no nonuniformity flat and smooth, and it is the chemical thing which is going to offer insurance and the approach of grinding economically. The variation in the thickness in the trouble of the conventional technique, i.e., chemical polishing, which carries out polish removal, Appearance polish nonuniformity common to chemical polishing or electrolytic polishing is lost and added. It not only can prevent the leakage of polish liquid, but Making easy attachment and detachment of a metal electrode peculiar to electrolytic polishing etc. the activity concerned safely And it says that the new polish equipment used for the inside polish approach of a metal hollow object remarkably improvable also on a polish quality target economically and this will be offered, and can apply not only to chemical polishing but to any of electrolytic polishing. Moreover, the target metal hollow object is applicable not only to niobium but the pipe which consists of copper, stainless steel, aluminum, etc. and the variant hollow inside-of-the-body side where the center section of the pipe swelled to the globular form like the acceleration cavity by selecting polish liquid suitably.

[0006]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem according to invention of claim 1, it has opening to the both ends of a longitudinal direction, respectively. The process which is chemical polishing or the approach of carrying out electrolytic polishing about the inside of the metal hollow object equipped with the peripheral surface of the abbreviation symmetry of revolution about the medial axis of a longitudinal direction, leaves at least one dipping part and carries out the seal of the both-ends opening of said metal hollow object to the exterior, The polish process at which an internal abbreviation lower half supplies polish liquid so that it may be immersed in polish liquid while rotating said metal hollow object about said medial axis, where a longitudinal direction is held horizontally, It is characterized by having the process which samples polish liquid by making it stand up to the condition that a longitudinal direction becomes perpendicular, maintaining rotation concerning said medial axis in said metal hollow object after termination of a polish process.

[0007] According to invention of claim 2, said dipping part consists of one [at least] openings of said metal hollow object including the liquid supply pipe *****(ed) inside said metal hollow object, and it is characterized by doing the **** activity or the sampling activity of this liquid supply pipe in the condition that the longitudinal direction of said metal hollow object becomes perpendicular. Moreover, according to invention of claim 3, said liquid supply pipe is suitably equipped with two or more discharge openings for every spacing along with a longitudinal direction, and it is characterized by orientation being carried out as each discharge opening carries out the regurgitation of the polish liquid towards the vertical upper part in said polish process. Furthermore, it is characterized by to have the washing process which flushes the polish liquid which remains in the inside of said metal hollow object, and polish remnants by injecting the penetrant remover pressurized from the discharge opening of said liquid supply pipe, maintaining the rotation about said medial axis in the condition that a longitudinal

direction becomes perpendicular from the interior of said metal hollow object about said metal hollow object after the process which samples polish liquid according to invention of claim 4. According to invention of claim 5, it returns to the condition that a longitudinal direction becomes level, after said washing process, maintaining rotation concerning said medial axis in said metal hollow object, and an internal abbreviation lower half is characterized by having the defecation process which continues supplying water while making pure water overflow so that it may be immersed in pure water further again. Moreover, according to invention of claim 6, a means to make pure water overflow in said defecation process is characterized by being used also [means / to hold the oil level of polish liquid uniformly in said polish process]. Furthermore, according to invention of claim 7, the oil level of polish liquid is set up so that the whole abbreviation for a liquid supply pipe may sink into liquid, and it is characterized by a liquid supply pipe being a metallic pipe which serves as the cathode at the time of electrolytic polishing.

[0008] Here, according to invention of claim 8, said metal hollow object is characterized by consisting of niobium, copper, stainless steel, or aluminum at least. Moreover, according to invention of claim 9, polish liquid is characterized by using at least the independent polish liquid of fluoric acid, a sulfuric acid, a nitric acid, a phosphoric acid, a chromic anhydride, a sodium hydroxide, and sodium phosphate which was, carried out and mixed two or more kinds suitably. Furthermore, according to invention of claim 10, a polish process is characterized by being constituted including continuously the phase of chemical polishing for removing the surface discontinuity by mechanical polishing of a last process, and the phase of electrolytic polishing for mirror-plane-izing further the inside removed in surface discontinuity by this chemical polishing.

[0009] Next, invention of claim 11 is invention about the equipment for enforcing the approach of claims 1-10. They are chemical polishing or equipment for carrying out electrolytic polishing about the inside of the metal hollow object which has opening to the both ends of a longitudinal direction, respectively, and is equipped with the peripheral surface of the abbreviation symmetry of revolution about the medial axis of a longitudinal direction. The stand which supports said metal hollow object in the pivotable condition about said medial axis, A means by which the longitudinal direction of said metal hollow object enables rotation of said stand from a level condition to a condition perpendicular at least, It is characterized by having a means to be installed on said stand and to give turning effort to said metal hollow object, and the means which leaves at least one dipping part and carries out the seal of the both-ends opening of said metal hollow object to the exterior.

[0010] According to invention of claim 12, the means which carries out the seal of the both-ends opening of said metal hollow object The fixed part of the pair which estranges rather than the overall length of said metal hollow object, is installed on said stand, and equips with cylinder-like inner skin the field which carries out phase opposite, It has the peripheral face of the shape of a cylinder fitted in said inner skin of this fixed part, and is characterized by consisting of the rotation section of the pair with which both-ends opening of said metal hollow object is equipped in airtight, and the ** ARINGU section which connects between said rotation sections and fixed parts free [rotation], holding sealing. Moreover, according to invention of claim 13, the member which constitutes said fixed part, rotation section, and bearing section is characterized by the front face which touches the whole or polish liquid consisting of combination of one sort thru/or two kinds or more of organisms of a fluororesin, polyethylene resin, polypropylene resin, polyimide resin, polyvinyl chloride resin, and a fluororubber. Furthermore, according to invention of claim 14, including the liquid supply pipe with which said dipping part penetrates the core of the fixed part of said pair, this liquid supply pipe is suitably equipped with two or more discharge openings for every spacing along with a longitudinal direction, and each discharge opening is characterized by carrying out opening so that orientation may be carried out to the vertical upper part, when the longitudinal direction of said metal hollow object is held at a level condition. According to invention of claim 15, said liquid supply pipe is a metal pipe which serves as the cathode at the time of electrolytic polishing, and it is characterized by connecting the metal hollow object to the energization member by the side of the anode plate installed on the stand electrically through a slide member further again. Moreover, according to invention of claim 16, one side is

equipped with suction opening from the open air for maintaining the internal pressure of a metal hollow object for the exhaust port for exhausting the harmful gas generated during polish to atmospheric pressure in another side among the fixed parts of said pair, and it is characterized by connecting the suction exhauster for making said suction opening into negative pressure in said exhaust port.

[0011]

[Embodiment of the Invention] The whole inside polish equipment configuration of the metal hollow object by this invention is shown in drawing 1. One is a metal hollow object among drawing. This example explains the case where the inside of 5 ream cavities which consist of niobium material used as a superconduction acceleration cavity is ground. This metal hollow object 1 has the multiple-string spherical peripheral surface to which it is the hollow cylinder object which has opening to the both ends of a longitudinal direction, and a radius repeats increase and decrease periodically along with a longitudinal direction. It has the flange for equipping the periphery of opening. Thus, with this equipment, the metal hollow object 1 is held using the hollow object maintenance metallic ornaments (fixture) 4 so that handling [the metal hollow object 1 which has a special configuration] easily. In this example, the part into which the both ends of 5 ream cavities swelled is held along an equatorial plane. Through these hollow object maintenance metallic ornaments 4, rotation is given to the metal hollow object 1, or the current in the case of electrolytic polishing is supplied. The hollow object maintenance metallic ornaments 4 are equipped with the spur gear 15, and it can rotate now with the angular velocity of arbitration through a spur gear 14 from the motor 3 fixed to the stand 2. Moreover, the hollow object maintenance metallic ornaments 4 are equipped with carbon brushes 8a and 8b, and by contacting sliding on contact of the anode plate side feeder system with which these have been arranged in the center section of the stand 2, even if the metal hollow object 1 is rotating to a stand 2, electric power can be supplied to the metal hollow object 1.

[0012] Here, the rotation device of a stand 2 is explained. A stand 2 can rotate a center section now to the condition which rotated 90 degrees in the direction shown in the point mark R, and stood straight in it from the level condition which is supported pivotably at the rotation core c, for example, was illustrated by telescopic motion of an oil hydraulic cylinder 17. When equipping a stand 2 with the metal hollow object 1 or doing the activity which extracts the activity or this which **** the liquid supply pipe 6 for polish liquid supply inside the metal hollow object 1, the activity which removes the metal hollow object 1 from a stand 2 in a list, it is made to rotate in the direction which shows a stand 2 to an arrow head R, and after the metal hollow object 1 has stood straight, it works. Moreover, when doing the activity ground while accumulating polish liquid 13 in the interior of the activity which supplies polish liquid 13 to the interior of the metal hollow object 1, and the metal hollow object 1 and rotating the metal hollow object 1, it carries out, maintaining at the level condition that the stand 2 was illustrated. Furthermore, when doing the activity to which the effluent of the polish liquid 13 is promptly carried out after polish termination, and the activity which supplies a penetrant remover to the interior of the metal hollow object 1 from said liquid supply pipe 6, it is made to rotate in the direction which shows a stand 2 to an arrow head R, rotating the metal hollow object 1, and it carries out, leaning the metal hollow object 1 to the condition of having stood straight from the level condition.

[0013] The flange of the both ends of the metal hollow object 1 is equipped with the sleeves 5a and 5b which have cross-section structure as shown in drawing 2 and drawing 3, respectively. Hereafter, the structure of these sleeves 5a and 5b is explained in detail. These sleeves 5a and 5b are constituted only using chemical-resistant plastic material. Specifically, the combination of one sort thru/or two kinds or more of organisms of a fluororesin, polyethylene resin, polypropylene resin, polyimide resin, polyvinyl chloride resin, and a fluororubber or a front face consists of the rigid bodies covered with these resin. About sleeve 5a which becomes the bottom when uprighting the metal hollow object 1, it has cross-section structure as shown in drawing 2, and has cross-section structure as shown in drawing 3 about sleeve 5b which becomes the bottom when uprighting the metal hollow object 1. Each sleeves 5a and 5b were divided roughly, consist of three parts, and consist of the rotation section (part to which the slash was given in the two directions among drawing) which rotates with the metal hollow object 1, a fixed part (part to which the slash was given among drawing in the one direction) fixed to a stand 2, and

sealing bearing which makes these both pivotable relatively while keeping sealing perfect. Especially about sealing bearing, it has structure which can be rotated smoothly, keeping sealing perfect, even if it is required to maintain the sealing engine performance even if it is in the condition in which the metal hollow object 1 stood straight and is in a level condition and gravity is applied to the longitudinal direction (shaft orientations) list of the metal hollow object 1 in which direction of radial.

[0014] First, since the inside ring of the ball bearing 40a and 40b is fixed to the periphery section of the rotation cylinder objects 20a and 20b, it is described as the rotation cylinder objects 20a and 20b used as a body, and the flange stoppers 21a and 21b for fixing the flange of the metal hollow object 1 to this, and it is constituted from the ARINGU stoppers 22a and 22b by the rotation section of Sleeves 5a and 5b. Moreover, since the outside ring of the ball bearing 40a and 40b is fixed to the inner circumference section of the wrap disc-like lids 31a and 31b and the fixed cylinder objects 30a and 30b, the end face of the fixed cylinder objects 30a and 30b used as a body and the fixed cylinder objects 30a and 30b is described, and it is constituted from the ARINGU stoppers 32a and 32b by the fixed part of Sleeves 5a and 5b. between the fixed cylinder objects 30a and 30b and Lids 31a and 31b -- O rings 33a and 33b -- fixed cylinder object 30a -- it can 30b fly and O rings 34a and 34b are arranged among the ARINGU stoppers 32a and 32b, respectively. The liquid supply pipe 6 is ****(ed) by the core of the disc-like lids 31a and 31b. Between the periphery section of the liquid supply pipe 6, and Lids 31a and 31b, O rings 35a and 35b are arranged, and sealing is maintained by binding tight by the fixed plugs 36a and 36b further.

[0015] About sleeve 5a which becomes the bottom when uprighting the metal hollow object 1, as shown in drawing 2 and drawing 1, the exhaust port 11 for exhausting Myst (fog) and gas which occur inside the metal hollow object 1 is established. Moreover, about sleeve 5b which becomes the bottom when uprighting the metal hollow object 1, as shown in drawing 3 and drawing 1, while the internal pressure control opening 10 for controlling the pressure inside the metal hollow object 1 is formed, the effluent opening 16 for discharging internal polish liquid and the internal penetrant remover of the metal hollow object 1 is formed. With this equipment, since a stand 2 is rotated and polish liquid is discharged promptly, rotating the metal hollow object 1 after polish termination, the effluent opening 16 is formed in a location which is always hidden into liquid, and an exhaust port 11 and the internal pressure control opening 10 are formed in a location which is always kept higher than an oil level.

[0016] In addition, by having divided an exhaust port 11 and the internal pressure control opening 10 into one edge each of the metal hollow object 1, and having arranged them Since the internal pressure control opening 10 will act as the open air or inert gas absorption opening whenever it connects the exhaust port 11 to the suction exhauster (not shown), the harmful gas generated during polish inside the metal hollow object 1 will always flow and go in the direction of an exhaust port 11, without piling up inside.

[0017] Moreover, the overflow holes 37a and 37b for maintaining the oil level of the polish liquid inside the metal hollow object 1 at the time of polish are formed in each fixed cylinder objects 30a and 30b. The cross-section structure of the part of this overflow hole is shown in drawing 4. Drawing 4 shows the cross section about the A1A line of drawing 2, and six show the fracture surface of a liquid supply pipe among drawing. Since this liquid supply pipe 6 serves as the cathode at the time of electrolytic polishing, the location (height) of an overflow hole is set up so that this liquid supply pipe 6 may maintain the oil level of polish liquid so that it may be immersed into polish liquid. The polish liquid which overflowed from the overflow hole is returned to the cistern (not shown) of polish liquid through the liquid return piping 9a and 9b.

[0018] Next, sealing bearing which makes the rotation section and a fixed part pivotable relatively while maintaining internal and external sealing consists of ball bearing 40a and 40b and ring seals 41a and 41b. The ball bearing 40a and 40b consists of the inside ring fixed to the periphery section of the rotation section, and the outside ring fixed to the inner circumference section of a fixed part, and two or more balls are arranged between the inside ring and the outside ring. When it is in a level condition as the metal hollow object 1 indicated to be to drawing 1, the weight of the metal hollow object 1 is supported to radial [of the ball bearing 40a and 40b], and when it is in the condition in which the metal

hollow object 1 stood straight, the weight of the metal hollow object 1 is supported to the shaft orientations of the ball bearing 40a and 40b. Therefore, even if it is in the condition which stood straight even if the metal hollow object 1 was in the level condition, the weight of the metal hollow object 1 is not added and the sealing pressure based on the elastic deformation of the relative physical relationship of the rotation section and a fixed part and ring seals 41a and 41b only joins ring seals 41a and 41b. Thereby, fatigue of ring seals 41a and 41b was mitigated, and the life was extended remarkably. And when polish liquid and a penetrant remover serve both as the lubricant and coolant of the ball bearing 40a and 40b, the seizure of the ball bearing 40a and 40b is not generated, either, but it can be equal also to continuation polish of long duration.

[0019] The explanation about the structure of Sleeves 5a and 5b is ended above, next the liquid supply pipe 6 is explained. Supply of polish liquid, supply of a penetrant remover, and in the case of electrolytic polishing, this liquid supply pipe 6 serves as three roles of the function of an electrode (cathode). In this example, while realizing the function as an electrode by using a metal hollow pipe and the hollow pipe of especially the product made from aluminum, the function of supply of polish liquid and supply of a penetrant remover is realized by establishing two or more deliveries for carrying out the regurgitation of the polish liquid in the perimeter of the hollow pipe made from this aluminum along with a longitudinal direction. As shown in the arrow head d of drawing 1, when the metal hollow object 1 is held horizontally, orientation of the delivery of polish liquid is carried out so that polish liquid may be breathed out toward the upper part. The end of the liquid supply pipe 6 is used as the liquid supply opening 12 for supplying polish liquid or a penetrant remover, and the other end is blockaded. Moreover, the cathode terminals 7a and 7b are connected to the both ends of the metal liquid supply pipe 6, and it connects with the cathode side of a rectifier. In addition, in case the liquid supply pipe 6 is removed after polish termination, having arranged the liquid supply opening 12 at the edge which serves as the bottom at the time of erection of the liquid supply pipe 6 considers so that a penetrant remover etc. may not remain in the liquid supply pipe 6.

[0020] The explanation about the structure of this equipment is ended above, and how to use this equipment next and grind the inside of the metal hollow object 1 is explained. First, while holding the metal hollow object 1 which should be ground by the hollow object maintenance metallic ornaments 4, it equips with the sleeves 5a and 5b which become both-ends opening of the metal hollow object 1 from the organism which has the chemical resistance which can carry out the seal of the polish liquid completely, respectively, and a stand 2 is equipped with them free [rotation]. At this time, a stand 2 works in the condition that make it rotate perpendicularly 90 degrees from the condition shown in drawing 1, and the longitudinal direction of the metal hollow object 1 turns into the direction of a vertical. In the case of electrolytic polishing, in the case of chemical polishing, a metal hole difference hollow pipe electrode can be inserted by this function again, without making the internal surface of the hollow object 1 contact from the upper part of opening by using a chemical-resistant hole difference hollow pipe as the liquid supply pipe 6. if it is for example, a hollow object made from niobium -- the hole made from pure aluminium -- a difference hollow pipe is inserted. Since chemical-polishing liquid can also be borne enough in the case of niobium material, the pipe made from aluminum for electrodes can use for the regurgitation pipe of chemical-polishing liquid, and a list also as a washing pipe.

[0021] Next, after two or more holes of the liquid supply pipe 6 are fixed so that it may become the direction of facing up when they make the metal hollow object 1 sideslip horizontally, a stand 2 is rotated horizontally and the metal hollow object 1 is returned to the condition which shows in drawing 1. In the case of electrolytic polishing, the metal hollow object 1 is connected to a rectifier at an anode plate so that the metal liquid supply pipe 6 may serve as cathode again, and the liquid supply opening 12, the effluent opening 16, Myst, a pipe, a hose of gas respectively required for an exhaust port 11, etc. are connected. If it equips with the air filter which had chemical resistance in the inlet 10 in order to compensate Myst and the reduced pressure condition of the hollow object 1 interior accompanying exhaust air of gas, mixing of the dust carried in out of atmospheric air is prevented, and contamination of polish liquid can be prevented. Moreover, if nitrogen gas etc. is introduced, polish by the inert atmosphere will also be attained.

[0022] If the polish liquid 13 by which the temperature control was carried out is sent into the polish liquid liquid supply opening 12 from a polish liquid tank with a pump, rotating the hollow object 1 finally Polish liquid 13 is led [be / it / under / of the liquid supply pipe 6 / passing] to the interior of the metal hollow object 1 from two or more deliveries, and the liquid supply pipe 6 is discharged from the polish liquid exhaust ports 9a and 9b in the condition of having been immersed into polish liquid nearly completely, and it returns to a polish liquid tank again. Since the discharge direction of polish liquid 13 is made into facing up and it is not directly put to the jet of the polish liquid 13 which the inside of the metal hollow object 1 which it is immersed in polish liquid 13 and ground breathes out in here, there is no local rate-of-flow nonuniformity, and polish appearance nonuniformity disappears as a result, and it becomes possible to acquire the polished surface of high quality. For example, when it breathed out in the direction of a lower part conventionally to the amount of polish removal of 100-micrometer target to a niobium hollow object in the case of electrolytic polishing, what had produced the level difference of about 20-30 micrometers in the boundary section with a regurgitation side became that there is nothing. Moreover, at the time of chemical polishing, the polish level difference of about 40-60 micrometers was canceled by even about 0.

[0023] If polish of the metal hollow object 1 is completed, where rotation of the metal hollow object 1 is maintained If the wash water which discharged polish liquid 13 from the metal hollow object 1 to the tank of polish liquid, and was subsequently pressurized from the delivery of the liquid supply pipe 6 is supplied making a stand 2 do a handstand to a perpendicular 90 degrees

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CLAIMS

[Claim(s)]

[Claim 1] They are chemical polishing or the approach of carrying out electrolytic polishing about the inside of the metal hollow object which has opening to the both ends of a longitudinal direction, respectively, and is equipped with the peripheral surface of the abbreviation symmetry of revolution about the medial axis of a longitudinal direction. The process which leaves at least one dipping part and carries out the seal of the both-ends opening of said metal hollow object to the exterior, The polish process at which an internal abbreviation lower half supplies polish liquid so that it may be immersed in polish liquid while rotating said metal hollow object about said medial axis, where a longitudinal direction is held horizontally, The inside polish approach of the metal hollow object characterized by having the process which samples polish liquid by making it stand up to the condition that a longitudinal direction becomes perpendicular while maintaining rotation concerning said medial axis in said metal hollow object after termination of a polish process.

[Claim 2] It is the inside polish approach of the metal hollow object according to claim 1 which said dipping part consists of one [at least] openings of said metal hollow object including the liquid supply pipe ****(ed) inside said metal hollow object, and is characterized by doing the *** activity or the sampling activity of this liquid supply pipe in the condition that the longitudinal direction of said metal hollow object becomes perpendicular.

[Claim 3] It is the inside polish approach of the metal hollow object according to claim 2 which said liquid supply pipe is suitably equipped with two or more discharge openings for every spacing along with a longitudinal direction, and is characterized by orientation being carried out as each discharge opening carries out the regurgitation of the polish liquid towards the vertical upper part in said polish process.

[Claim 4] The inside polish approach of the metal hollow object according to claim 3 characterized by to have the washing process which flushes the polish liquid which remains in the inside of said metal hollow object by injecting the penetrant remover pressurized from the discharge opening of said liquid-supply pipe while maintaining the rotation about said medial axis in the condition that a longitudinal direction becomes perpendicular from the interior of said metal hollow object about said metal hollow object after the process which samples polish liquid, and polish remnants.

[Claim 5] The inside polish approach of a metal hollow object according to claim 4 that it returns to the condition that a longitudinal direction becomes level, after said washing process, maintaining rotation concerning said medial axis in said metal hollow object, and an internal abbreviation lower half is characterized by having the defecation process which continues supplying water while making pure water overflow so that it may be immersed in pure water.

[Claim 6] A means to make pure water overflow in said defecation process is the inside polish approach of the metal hollow object according to claim 5 characterized by being used also [means / to hold the oil level of polish liquid uniformly in said polish process].

[Claim 7] It is the inside polish approach of the metal hollow object according to claim 6 which the oil level of polish liquid is set up so that the whole abbreviation for a liquid supply pipe may sink into

liquid, and is characterized by a liquid supply pipe being a metallic pipe which serves as the cathode at the time of electrolytic polishing.

[Claim 8] The inside polish approach of the metal hollow object according to claim 1 to 7 characterized by the metal hollow object consisting of niobium, copper, stainless steel, or aluminum at least.

[Claim 9] The inside polish approach of the metal hollow object according to claim 1 to 8 characterized by using at least the independent polish liquid of fluoric acid, a sulfuric acid, a nitric acid, a phosphoric acid, a chromic anhydride, a sodium hydroxide, and sodium phosphate which was, carried out and mixed two or more kinds suitably as polish liquid.

[Claim 10] A polish process is the inside polish approach of the metal hollow object according to claim 1 characterized by being constituted including continuously the phase of chemical polishing for removing the surface discontinuity by mechanical polishing of a last process, and the phase of electrolytic polishing for mirror-plane-izing further the inside removed in surface discontinuity by this chemical polishing.

[Claim 11] They are chemical polishing or equipment for carrying out electrolytic polishing about the inside of the metal hollow object which has opening to the both ends of a longitudinal direction, respectively, and is equipped with the peripheral surface of the abbreviation symmetry of revolution about the medial axis of a longitudinal direction. The stand which supports said metal hollow object in the pivotable condition about said medial axis, A means by which the longitudinal direction of said metal hollow object enables rotation of said stand from a level condition to a condition perpendicular at least, Inside polish equipment of the metal hollow object characterized by having a means to be installed on said stand and to give turning effort to said metal hollow object, and the means which leaves at least one dipping part and carries out the seal of the both-ends opening of said metal hollow object to the exterior.

[Claim 12] The means which carries out the seal of the both-ends opening of said metal hollow object The fixed part of the pair which estranges rather than the overall length of said metal hollow object, is installed on said stand, and equips with cylinder-like inner skin the field which carries out phase opposite, The rotation section of the pair with which is equipped with the peripheral face of the shape of a cylinder fitted in said inner skin of this fixed part, and both-ends opening of said metal hollow object is equipped in airtight, Inside polish equipment of the metal hollow object according to claim 11 characterized by consisting of the ** ARINGU section which connects between said rotation sections and fixed parts free [rotation], holding sealing.

[Claim 13] The member which constitutes said fixed part, rotation section, and bearing section is inside polish equipment of the metal hollow object according to claim 12 characterized by the front face which touches the whole or polish liquid consisting of combination of one sort thru/or two kinds or more of organisms of a fluororesin, polyethylene resin, polypropylene resin, polyimide resin, polyvinyl chloride resin, and a fluororubber.

[Claim 14] It is inside polish equipment of the metal hollow object according to claim 12 which this liquid supply pipe is suitably equipped with two or more discharge openings for every spacing along with a longitudinal direction, and is characterized by carrying out opening of each discharge opening so that orientation may be carried out to the vertical upper part, when the longitudinal direction of said metal hollow object is held at a level condition including the liquid supply pipe with which said dipping part penetrates the core of the fixed part of said pair.

[Claim 15] It is inside polish equipment of the metal hollow object according to claim 14 which said liquid supply pipe is a metal pipe which serves as the cathode at the time of electrolytic polishing, and is characterized by connecting the metal hollow object to the energization member by the side of the anode plate installed on the stand electrically through a slide member.

[Claim 16] Inside polish equipment of the metal hollow object according to claim 12 to 15 characterized by connecting the suction exhauster for equipping one side with suction opening from the open air for maintaining the internal pressure of a metal hollow object for the exhaust port for exhausting the harmful gas generated during polish to atmospheric pressure in another side among the fixed parts of said pair, and making said suction opening into negative pressure in said exhaust port.

[Translation done.]